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REGIONAL COOPERATION

Europe-Africa permanent link through the Strait of Gibraltar

Note by the Secretary-General

1. The Secretary-General has the honour to transmit to the Economic and Social Council the interim report prepared by the Executive Secretaries of the Economic Commission for Africa and the Economic Commission for Europe on the Europe-Africa permanent link through the Strait of Gibraltar.

2. In resolution 1989/119, the Economic and Social Council requested, inter alia, the Executive Secretaries of the Economic Commission for Africa and the Economic Commission for Europe:

(a) To submit, at the Marrakesh symposium, a global evaluation of the studies and work relating to the Europe-Africa permanent link through the Strait of Gibraltar, based on the reports of the Executive Secretaries transmitted by the Secretary-General to the Economic and Social Council;

(b) To allocate as far as possible the resources necessary for the evaluation of the studies and work relating to the project and of the results and recommendations of the Marrakesh symposium;

(c) To submit an interim report on the project to the Council at its second regular session of 1991.

Annex

EUROPE-AFRICA PERMANENT LINK THROUGH THE STRAIT OF GIBRALTAR

CONTENTS

		Paragraphs	Page
INTRODUCTION		1 - 5	3
I.	STUDIES OF THE SITE	6 - 23	4
II.	THE BRIDGE ALTERNATIVES	24 - 30	10
III.	THE TUNNEL ALTERNATIVE	31 - 33	13
IV.	LEGAL ASPECTS	34 - 45	15
V.	ECONOMIC ASPECTS	46 - 51	17
VI.	FUTURE ACTIVITIES	52 - 58	18
VII.	CONCLUSION	59 - 61	21

Figures

I. The Strait of Gibraltar: Three routes 6

II. Exchange of waters in the Strait 9

III. The bridge alternative: Sill route 12

IV. The tunnel alternative: Sill route 14

INTRODUCTION

1. A fixed crossing of the Strait of Gibraltar has been on the agenda of several international meetings since 1976. The Governments of Spain and Morocco, aware of the importance of such a permanent link for the economic and political relations of the two countries have cooperated in the studies under way, with a view to assessing the possibility of its construction. For this purpose, and within the scope of the Agreement on Scientific and Technical Cooperation between the Government of the Kingdom of Spain and the Government of the Kingdom of Morocco of 8 November 1979, the Governments signed, on 24 October 1980, a specific agreement establishing the legal basis for their cooperation. In the framework of this agreement, the two Governments decided to carry out a scientific and technical study on the fixed crossing project. To this end, they established a Joint Committee, composed of five members of each country. The agreement also foresaw the establishment of two national companies - the Moroccan Societé nationale d'études du Détroit (SNED) and the Spanish Sociedad de Estudios para la Comunicación Fija a Traves del Estrecho de Gibraltar (SECEG). The Joint Committee is mandated to direct the studies, coordinate action regarding the promotion of the project and coordinate and supervise the activities of the two companies.

2. Support for the fixed link had already been provided at the Third Conference of African Roads, held at Abidjan in October 1976, the Thirteenth Permanent Transport Conference of Arab Countries, held at Cairo in February 1977 and the Fourth Conference on African Roads, held at Nairobi in January 1980. The Conference of African Ministers of Transport, Communications and Planning, at its second session held at Addis Ababa in March 1981, took note of a feasibility study on the crossing of the Strait of Gibraltar by a permanent link. More recently, in 1989, the Governments decided to strengthen the agreement signed in 1980 by an additional agreement. The objectives of this newer engagement include the study of institutional schemes for the implementation of the project, as well as measures for its promotion at the international level to encourage scientific institutions to participate in the studies.

3. It is to be recalled that the Economic and Social Council, by resolution 1982/57, requested the Executive Secretaries of the Economic Commission for Africa (ECA) and the Economic Commission for Europe (ECE) to prepare a synthesis and an evaluation of the various studies and reports available regarding the proposed link through the Strait of Gibraltar. The Commissions were also requested to identify the problems connected with establishing a permanent link between the European road network and that of the region of the ECA, with a view to submitting proposals and recommendations to the Governments concerned for possible further action, and to report to the Economic and Social Council at its second regular session of 1983.

4. The present report is a follow-up to those similarly issued by the Executive Secretaries of the two Economic Commissions pursuant to Council resolutions 1982/57, 1983/62, 1984/75, 1985/70, 1987/69 and 1989/119. a/ In

resolution 1989/119, the Economic and Social Council requested, inter alia, the Executive Secretaries of the Economic Commission for Africa (ECA) and the Economic Commission for Europe (ECE) to submit at the Marrakesh symposium a global evaluation of the studies and work relating to the project based on the reports of the Executive Secretaries transmitted by the Secretary-General to the Economic and Social Council; to allocate as far as possible the resources necessary for the evaluation of the studies and work relating to the project and of the results and recommendations of the Marrakesh symposium; and to submit an interim report on the project to the Economic and Social Council at its second regular session of 1991.

5. Although the secretariats of the two Commissions do not have regular or extrabudgetary allocations to undertake these progress reports, they endeavour to fulfil the requests of the Council. As in the past, the Governments of Morocco and Spain continue to cooperate with the secretariats. A meeting of relevant officials, held at Madrid from 19 to 20 March 1991, was attended by representatives of ECA and ECE. One part of the present report, finalized during that meeting, is mainly based on the discussions of the Marrakesh symposium, which was convened as the Third International Colloquium on the Europe/Africa Permanent Fixed Link through the Strait of Gibraltar, and held from 16 to 18 May 1990. The other part reviews the programme of work approved by the Joint Committee.

I. STUDIES OF THE SITE

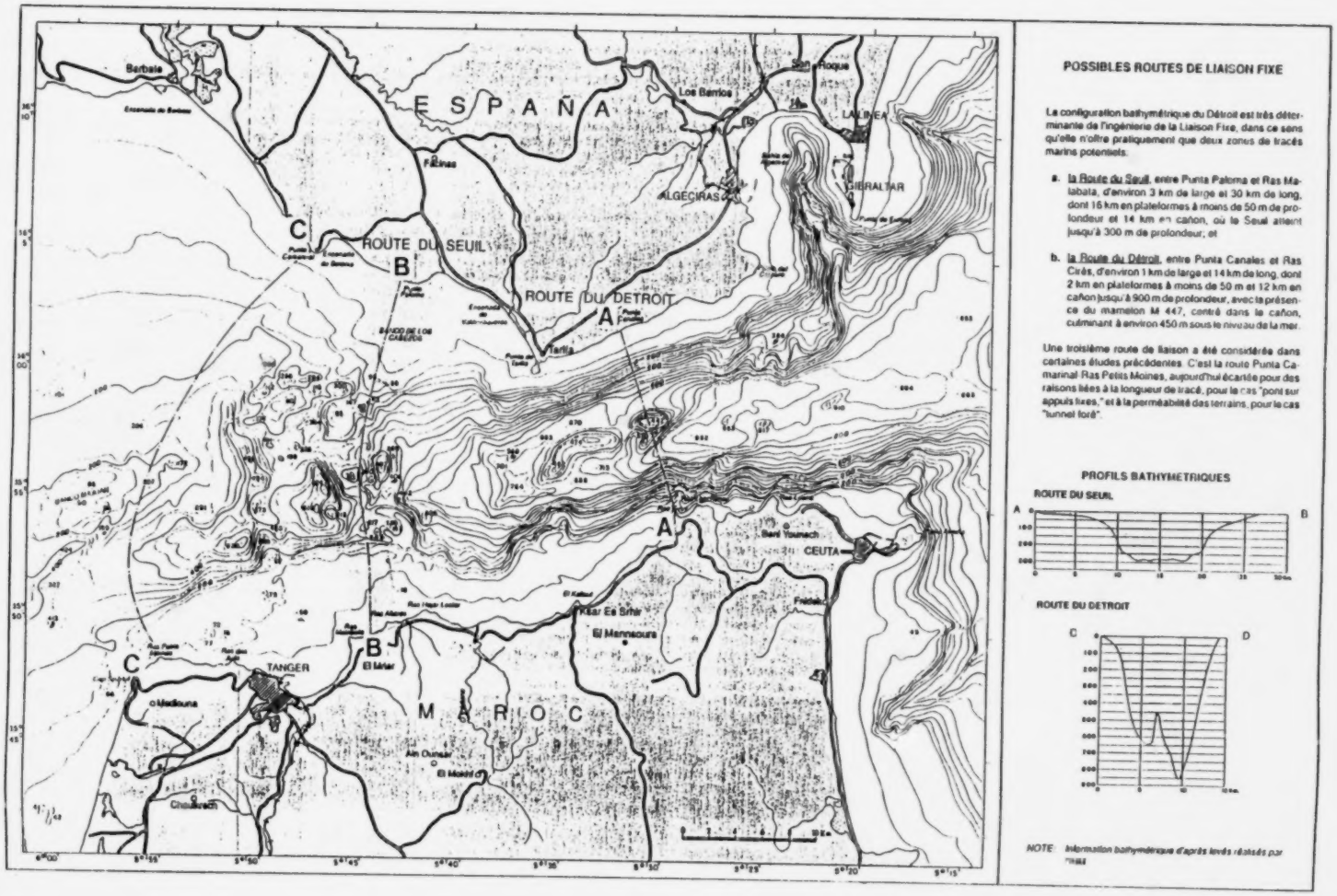
6. A Colloquium at Tangiers in 1980 reviewed the available information on the geology, geophysics, cartography, geodynamics and meteorology of the areas studied. Noting the importance of statistics on climatic, atmospheric and marine conditions, the Colloquium formulated a series of recommendations regarding the establishment of systems for the collection of physical and technical data on the above topics; the development of numerical programmes for calculations based on data on wave patterns; preparation of specific studies; and the establishment of a working group on meteorology. On economic and social issues, the Colloquium recommended a less detailed sectoral analysis for each construction type at the outset. In a second phase, all the possible implications of the project were to be studied. Detailed recommendations were made on action to be taken on geological and geophysical issues and meteorology as well as on the juridical aspects. Upon these recommendations, the Joint Committee proceeded to complete and/or update the existing information. Thus, a number of firms specializing in oceanography, geology and geophysics commenced their work.

7. The recommendations formulated by the initial technical meetings and the results of the evaluation of the experts mentioned above have formed the basis of the studies taken up between 1984 to 1989. Because of the length and importance of the work and the studies under way, the mandate given to ECA and ECE was extended through to 1991.

A. Physical data

8. For a crossing of the Strait of Gibraltar, three routes were considered. The first route (route A, the "Strait Route") stretches between Punta Canales and Ras Cires, a distance of about 14 kilometres. Of this, 12 km pass over waters less than 50 metres in depth, while the rest measures even as deep as 900 m rising around the middle of the Strait to 450 m. The second route considered (route B, the "Sill Route") is between Punta Paloma and Ras Malabata, a distance of 30 km, of which 16 km pass over a platform of less than 50 m depth and the rest over deeper waters up to 300 m. The third alternative (route C) is outermost towards the Atlantic Ocean and stretches between Cabo Trafalgar and Cape Spartel; it is 44 km long, over water-depths to 350 m (fig. I).

Figure I. The Strait of Gibraltar: Three routes


ESPAÑA
MAROC
ROUTE DU SEUIL
ROUTE DU DETROIT
A
B
C
Barbate
Los Barrios
Punta Paloma
ALGECIRAS
GIBRALTAR
Tarifa
Punta Carnero
Punta Cires
Punta Canales
Banco de los Cabezos
Bank Yousach
CEUTA
Fnideq
Ksar Es Seghir
El Mannsoura
TANGER
El Mrier
Asilah
Arcila
Chouamach
POSSIBLES ROUTES DE LIAISON FIXE
La configuration bathymétrique du Détroit est très déterminante de l'ingénierie de la Liaison Fixe, dans ce sens qu'elle n'offre pratiquement que deux zones de tracés marins potentiels:
a. la Route du Seuil, entre Punta Paloma et Ras Malabata, d'environ 3 km de large et 30 km de long, dont 16 km en plateformes à moins de 50 m de profondeur et 14 km en canon, où le Seuil atteint jusqu'à 300 m de profondeur; et
b. la Route du Détroit, entre Punta Canales et Ras Cirés, d'environ 1 km de large et 14 km de long, dont 2 km en plateformes à moins de 50 m et 12 km en canon jusqu'à 900 m de profondeur, avec la présence du mamelon M 447, centré dans le canon, culminant à environ 450 m sous le niveau de la mer.
Une troisième route de liaison a été considérée dans certaines études précédentes. C'est la route Punta Camarinal Ras Petits Moines, aujourd'hui écartée pour des raisons liées à la longueur de tracé, pour le cas "pont sur appuis fixes," et à la perméabilité des terrains, pour le cas "tunnel foré".
PROFILS BATHYMETRIQUES
ROUTE DU SEUIL
ROUTE DU DETROIT
NOTE: Information bathymétrique d'après levés réalisés par

/...

Cartography

9. A geodetic network for geodynamic observations was set up, consisting of four measuring stations on each side of the Strait. The three objectives pursued were:

(a) To assess possible movements of the African and Eurasian continental plates in the area of the Strait;

(b) To provide a uniform reference for preparation of the cartography of the project area;

(c) To make it possible to stake out and conduct precise testing of the project area.

10. Major planimetry and altimetry work was carried out in Morocco and Spain.

11. Topographic and bathymetric maps of the region of the Strait have been prepared. The area was surveyed with conventional techniques in 1983 and 1984 and revised with newer techniques giving higher degrees of precision.

Meteorology

12. A meteorological programme was launched, with the aim of intensifying the measurements, systematizing and analysing available meteorological data, and carrying out regional and specific climatological studies pertinent to the fixed link. Various data, including long chronological series relating to temperatures on both sides of the Strait (particularly in Tangiers, Morocco, and Tarifa, Spain) and those on the winds in the Straits are available. Under this programme, a set of three specialized meteorological stations were installed: one in Morocco (Malabata), one in Spain (Tarifa) and one mounted on a regular ferry servicing the Strait.

13. The objective of the meteorological studies was to supply basic data for forecasts. The most important variable noted in the study was wind, since the Strait is an area where dynamic and violent atmospheric action takes place. Work of a large number of specialists indicates that the dominant wind directions seem to be in the east-west with predominant easterly effects, especially in Tarifa. The highest velocity reported was 224 km per hour in Tangiers, 147 in Tarifa and 154 in Gibraltar.

14. The annual average temperature on the two coasts is about 17° C with maximal points in August, about 24° C, and minimal in January, around 13° C. Extreme temperatures being 41° C in Tangiers and -3° C in Tarifa. The annual average precipitation is 750 mm, about 90 per cent of which falls between October and May. The visibility of less than 5 nautical miles varies about 5 to 10 per cent and the humidity is 75 per cent for about 3,000 hours per year around the Tangiers area.

Physical oceanography

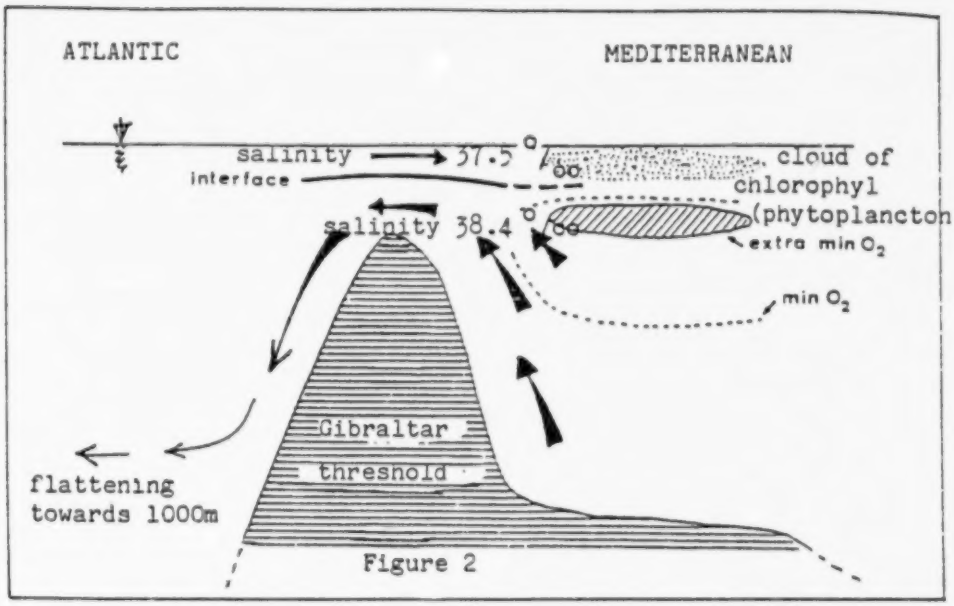
15. The project's authorities are proceeding with the analysis of the results of the investigations carried out between October 1985 and October 1986 by the Office of Naval Research of the United States Navy in cooperation with different Moroccan and Spanish institutions on meteorological and sea current measurements in the Strait with the objective of establishing a hydrographic model of the area. Buoys were fixed with anchors and placed in the Strait of Gibraltar. The data collected are transmitted by radio to Morocco and Spain. The programme on this issue will make it possible to define those variables that are necessary for determining the kind of structure to construct in the sea.

16. Tides are between 256 centimetres maximal and 18 cm minimal points.

17. Observation points established since 1985 have registered the wave patterns in the Strait. However, this period is not long enough to yield sufficient data. Furthermore, there are problems concerned with the conditions of registering during storms. Keeping these limitations in mind, an analysis of the data indicates that 50 per cent of the time, wave heights were less than 1 m and the average period was less than 55 seconds. The maximum registered wave heights were 4.5 m for scaler measurements and 5.5 m for measurements by directional buoys, with an average of 125 seconds. The waves measured in the north-west were slightly higher than those measured in the south-west. The Strait of Gibraltar has extensive current activity of very complex structure. One current on the high level is from the Atlantic towards the Mediterranean and the other, deeper one, from the Mediterranean to the Atlantic with an interface of complex geometry. The experiments were centred on evaluating the importance of this exchange of water between the Mediterranean and the Atlantic as well as the dynamics of this process, and on defining a strategy of measurements.

18. Their efforts so far indicate that the maximum current velocity is around 6 knots; the tides affect east-west currents by 1 metre per second (m/s), the normal east-west currents fluctuate between 0.4 m/s with an amplitude of 15 to 20 days. It should be noted that chemical analysis of the waters clearly indicates the region where the samples come from.

Figure II. Exchange of waters in the Strait



Seismicity

19. A dense network of seismic stations with adequate azimuthal distribution was established on the two sides of the Strait. The network comprises 10 stations, 5 on each side. The stations are interconnected for simultaneous reception of data in real time from the entire network. Since the Strait is located near the contact zone of the European and African continental plates, it was deemed necessary to carry out the following:

(a) Studies on seismic history of the area, including an inventory of seismic occurrences;

(b) Observations of seismicity, using instruments to show the geographical distribution of seismic events, in order to provide an indication of the internal structure of the area. The observation network was started in 1987. Work is expected to be completed in about five years. They will give an idea of the spatial and temporal frequency of the seismic activity and the physical characteristics of the areas affected.

20. The 10 stations on the two coasts have been operational since 1987, registering seismic activity, and the highest magnitude noted is 4.20 on the Richter scale. It is generally accepted that for a meaningful interpretation, data for much longer periods are necessary.

Geology and geotechnics

21. There is continuity in the geological formations that jut out on both sides of the Strait. The formations concerned in the project are the flysch units and their relative substratum: the Tangiers/Almarchal unit. The structure of the flysch is affected by tectonic upheavals that cause scaling and faulting. It is, therefore, very complex and no reliable cross section in a north/south direction can be proposed on the basis of current knowledge. Five units of flysch have been identified and various test drillings have proved that the different formations are all impervious. Geological studies include those made on dry land and in water and have resulted in detailed information as to the materials, their characteristics as well as their placement and dimensions. Work in this regard still continues.

22. Test surveys were carried out until 1990 over a total distance of 12,000 km. It was followed by two long deep penetration seismic profiling tests. The main lesson learned in the surveys was that the post-tectonic basins and the sandy zones and areas of non-consolidated sediments are clearly identifiable, whereas it was difficult to demarcate the various flysch units and determine their structure. Efforts to interpret the data from the surveys and to proceed with other off-shore explorations are continuing. A seismic refraction investigation on land was carried out near Tangiers from March to September 1987. The next stage consisted of the construction of a close-mesh covering.

23. The above studies for the collection of physical data on the construction site have yielded precious information, and efforts in these fields will continue for lengthy periods possibly extending even beyond the completion of construction.

II. THE BRIDGE ALTERNATIVES

24. The bridge alternative was also analysed with three routes in mind:

Route A. The arguments for this route are that: the possibility of collision against piers is reduced because of the 5-km span between the three main piers; navigation becomes safer because of these large openings; the total route is shorter; and since it is well within the Strait, the structure will be more sheltered. The arguments against are: high construction costs; the necessity for extensive research on materials; design features including the extremely large spans of 5 km; and construction techniques.

Route B. The arguments for this route are: main piers are at 2 km apart, thus bringing the span limit within the existing technology; the depths of the piers, though difficult, are attainable. Those against this route quote the long length, the decreased safety to navigation because of the shorter span between piers and the fact that the bridge would be more exposed to ocean conditions.

Route C. The conditions are similar to those stated for route B, except that the distance is longer by 14 km.

25 At present, detailed studies are concentrated on route B, the Sill Route (fig. III).

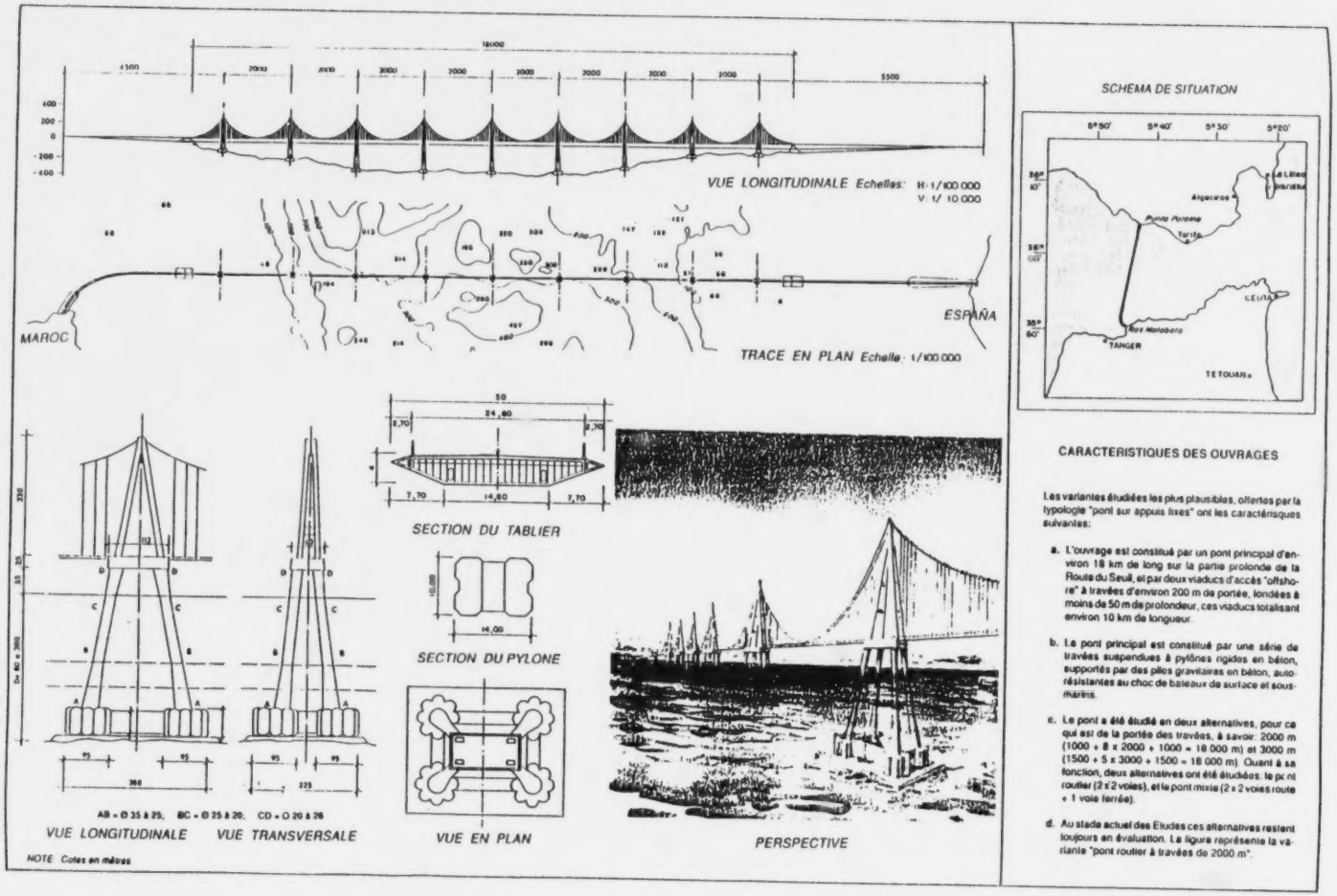
26. Preliminary analyses have indicated that a rail only bridge would not be economical. Therefore, a road only, or a mixed road and rail, bridge are being studied. The preliminary feasibility analyses have brought to light that the physical conditions required by the two types of crossings could, in principle, be met through existing engineering technology.

27. Regarding the span of the bridge, initial studies show that a minimum span of 2,000 m should be considered for various purposes, including the juridical aspects of the passage of ships through the Strait. The requirements of maritime traffic also necessitate 70 m of height in the central span and 25-70 m on the site spans. This includes a consideration also for future developments in shipping technology. The physical aspects and dimensions, as well as the type of bridge that may be built across the Strait of Gibraltar, have been analysed from the point of view of legal limitations, economy and technical possibilities. These indicate, for instance, that up to 5,000-m spans could be studied with the understanding that special engineering research will be launched before any firm decisions are taken.

28. The studies made by SNED and SECEG so far seem to cover a large number of possible construction solutions to a bridge crossing. The studies include structural elements, such as materials, depth, cable characteristics, design of a deck to be used, the main piers, the design parameters of the main piers from the point of view of safety, including energy-absorbing protector systems or other general considerations, auxiliary systems and durability. Special reference is made to the technology that has developed as a result of offshore petroleum research activities. For instance, the anchorage of the voluminous structure that would be required for a construction at such depths needs special attention. In the same manner, access viaducts need to be designed for specific issues. Some of the engineering studies have come up with novel solutions to problems posed - for instance, on the subject of the safety of the piers against ship collisions.

29. In broad lines, it can be stated that the analyses so far have defined the problems that would affect feasibility as well as their solutions. However, an optimal construction type has not yet been selected. Main issues like the crossing corridor, the structure type and other details of essential elements are still to be further evaluated.

Figure III. The bridge alternative: Sill route


VUE LONGITUDINALE Echelles: H: 1/100 000
V: 1/ 10 000
MAROC
ESPAÑA
TRACE EN PLAN Echelle: 1/100 000
SECTION DU TABLIER
SECTION DU PYLONE
AB = Ø 35 à 25, BC = Ø 25 à 20, CD = Ø 20 à 26
VUE LONGITUDINALE
VUE TRANSVERSALE
VUE EN PLAN
PERSPECTIVE
NOTE Cotes en mètres
SCHEMA DE SITUATION
Algeciras
Gibraltar
Punta Paloma
Tarifa
CEUTA
Rio Martorio
TANGER
TETOUAN
CARACTERISTIQUES DES OUVRAGES
Les variantes étudiées les plus plausibles, offertes par la typologie "pont sur appuis fixes" ont les caractérisques suivantes:
a. L'ouvrage est constitué par un pont principal d'environ 18 km de long sur la partie profonde de la Route du Seuil, et par deux viaducs d'accès "offshore" à travées d'environ 200 m de portée, fondées à moins de 50 m de profondeur, ces viaducs totalisant environ 10 km de longueur.
b. Le pont principal est constitué par une série de travées suspendues à pylônes rigides en béton, supportés par des piles gravitaires en béton, autorésistantes au choc de bateaux de surface et sous-marins.
c. Le pont a été étudié en deux alternatives, pour ce qui est de la portée des travées, à savoir: 2000 m (1000 + 8 x 2000 + 1000 = 18 000 m) et 3000 m (1500 + 5 x 3000 + 1500 = 18 000 m). Quant à sa fonction, deux alternatives ont été étudiées: le pont routier (2 x 2 voies), et le pont mixte (2 x 2 voies route + 1 voie ferrée).
d. Au stade actuel des Etudes ces alternatives restent toujours en évaluation. La figure représente la variante "pont routier à travées de 2000 m".

Conclusions on the bridge alternative

30. The preliminary conclusions that can be deduced from these studies so far are that the bridge alternative is feasible with the following provisos:

(a) There will be a certain amount of interference with the maritime traffic;

(b) It will be necessary to protect the construction against ship collisions;

(c) While the construction of foundations at depths more than 200 metres is possible, very deep foundations, like 500 m, could be envisaged only after extensive studies;

(d) While the structural solution of 2,000- to 3,000-m spans are feasible, spans to 5,000 m would necessitate profound studies;

(e) The establishment of detailed terrain qualities is necessary;

(f) Special composite materials could be used for construction upon long research;

(g) Further studies are necessary on traffic;

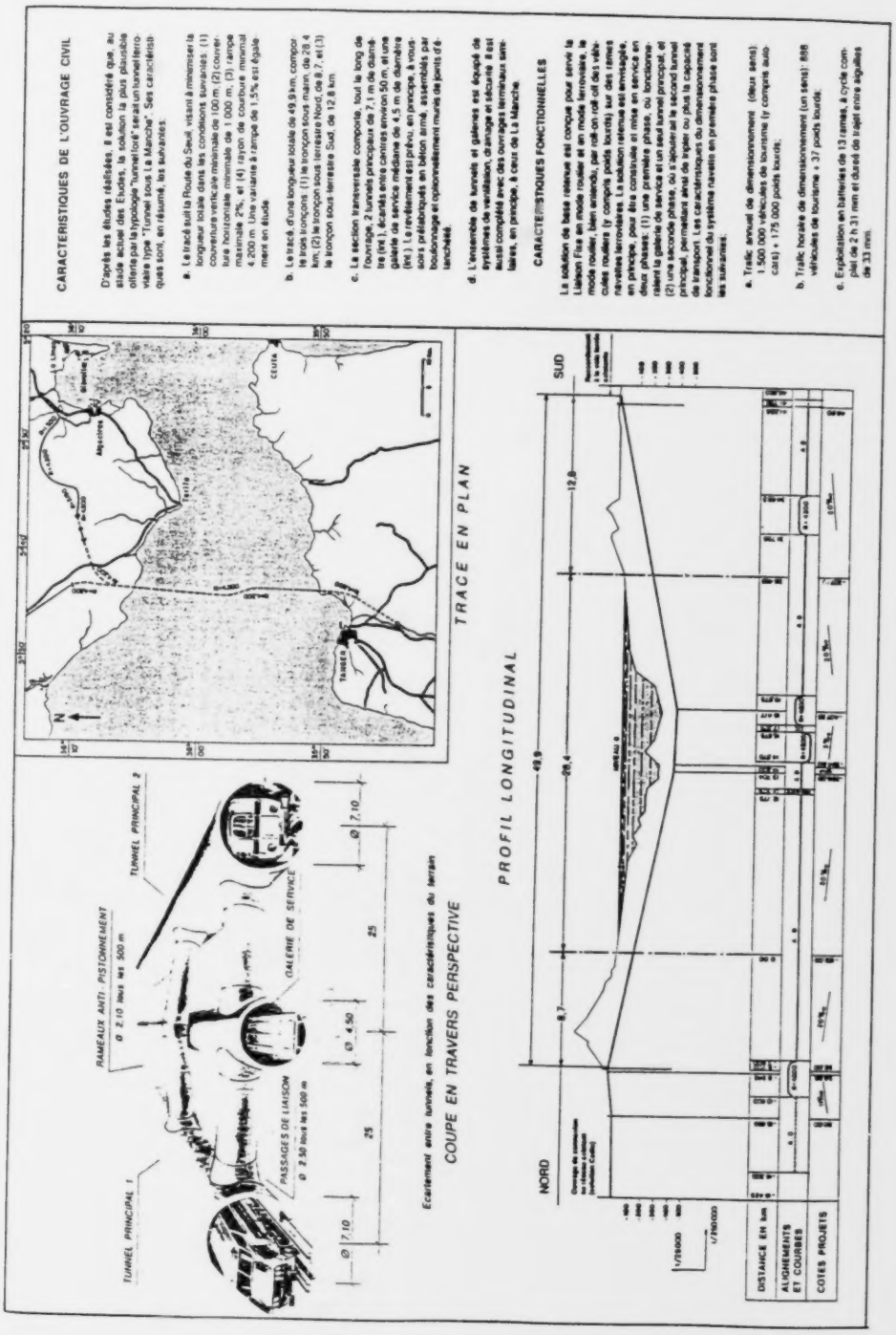
(h) Dominant physical conditions in the area from the point of view of seismicity, waves, tides and other features need additional analyses.

III. THE TUNNEL ALTERNATIVE

31. The tunnel alternative is studied for the time being only for the rail mode, since a preliminary evaluation has indicated that problems of ventilation and psychological effects of long tunnels would be difficult to surmount for a conventional road mode. Two solutions were considered with regard to the transverse configuration of the tunnel: one main double-track tunnel with a service tunnel, or two main single-track tunnels with a service tunnel. The technological feasibility of an isolated service tunnel was also studied.

32. It is envisaged to bore two or three galleries at a depth of minimum about 100 m under sea overburden. The principal function of the tunnel solution will be to transport passengers, goods and vehicles mounted on rail wagons. The liaison of the tunnel with the existing transport infrastructure will necessitate the construction of new rail sections on the Spanish side. According to the exact entry point of the tunnel at Cadiz and/or at Algeciras these new sections could be 58 km or 25 km. On the Moroccan side, it will be sufficient to select a line to tie up with the existing system around the region of Tangiers. The liaison of the tunnel to the road system does not create any problems (fig. IV). (For the bridge alternative, problems in this respect are similar or even easier to solve.)

Figure IV. The tunnel alternative: Sill route


CARACTERISTIQUES DE L'OUVRAGE CIVIL
Depuis les études réalisées, il est considéré que, au stade actuel des Etudes, la solution la plus plausible offerte par le typologie "tunnel ferroviaire" serait un tunnel ferroviaire type "Tunnel sous la Manche". Ses caractéristiques sont, en résumé, les suivantes:
a. Le tracé suit la Route du Seuil visant à minimiser la longueur totale dans les conditions suivantes: (1) courbure horizontale minimale de 100 m; (2) courbure maximale 2%; et (4) rayon de courbure minimal 4.200 m. Une variante à rampe de 1,5% est également en étude.
b. Le tracé d'une longueur totale de 49,9 km, comporte trois tronçons: (1) le tronçon sous marin, de 28,4 km, (2) le tronçon sous terrestre Nord, de 8,7, et (3) le tronçon sous terrestre Sud, de 12,8 km.
c. La section transversale comporte, tout le long de l'ouvrage, 2 tunnels principaux de 7,1 m de diamètre (ext.), écartés entre cantres environ 50 m, et une galerie de service médiane de 4,5 m de diamètre (ext.). Le revêtement est prévu, en principe, à voussoirs préfabriqués en béton armé, assemblés par boulonnage et optionnellement munis de joints d'étanchéité.
d. L'ensemble de tunnels et galeries est équipé de systèmes de ventilation, drainage et sécurité. Il est aussi complété avec des ouvrages terminaux similaires, en principe, à ceux de La Manche.
CARACTERISTIQUES FONCTIONNELLES
La solution de base retenue est conçue pour servir la Liaison Fixe en mode routier et en mode ferroviaire, le mode routier, bien entendu, par roll-on roll off des véhicules routiers (y compris poids lourds) sur des rames ferroviaires ferroviaires. La solution retenue est envisagée, en principe, pour être construite et mise en service en deux phases: (1) une première phase, où fonctionnerait la galerie de service et un seul tunnel principal, et (2) une seconde phase, ou s'ajouterait le second tunnel principal, permettant ainsi de tripler ou plus la capacité de transport. Les caractéristiques du dimensionnement fonctionnel du système ferroviaire en première phase sont les suivantes:
a. Trafic annuel de dimensionnement (deux sens): 1 500 000 véhicules de tourisme (y compris autocars) + 175 000 poids lourds;
b. Trafic horaire de dimensionnement (un sens): 888 véhicules de tourisme + 37 poids lourds;
c. Exploitation en batteries de 13 rames, à cycle complet de 2 h 31 mn et durée de transit entre égales de 33 mn.
TRACE EN PLAN
PROFIL LONGITUDINAL
NORD
SUD
COUPE EN TRAVERS PERSPECTIVE
TUNNEL PRINCIPAL 1
TUNNEL PRINCIPAL 2
RAMEAUX ANTI PISTONNEMENT
PASSAGES DE LIAISON
GALERIE DE SERVICE
Ecartement entre tunnels, en fonction des caractéristiques du terrain

Conclusions on the tunnel alternative

33. With reference to existing know-how on similar tunnel constructions it is thought that the excavation of the tunnel through the Strait of Gibraltar is technically viable, with the following provisos:

(a) It is at present not possible to establish or to determine cost or construction time, since geotechnical and geological detailed information still must be collected. It is suggested that a surface gallery be dug to reach more dependable results on these points. Even before the commencement of construction of this gallery, an expensive operation of sample taking in water would have to be effected;

(b) Determination of the details of the tunnel option, including timing, sample taking, actual construction and equipment for construction, as well as for the operation of the tunnel and the risks involved, need to be extensively studied for decision-making.

IV. LEGAL ASPECTS

34. The Strait of Gibraltar is a passage linking two parts of the high seas. A specific feature of the Strait is that it is situated entirely within the territorial waters of the two States bordering it. No express agreement has been concluded between the two countries for the delimitation of these territorial waters, but it is accepted that the median line shall be the line of delimitation.

35. International maritime navigation in the Strait of Gibraltar is governed neither by a special international agreement nor by any customary law. The legal regime applicable is therefore the general regime. The 1958 Convention on the Territorial Sea and the Contiguous Zone, to which Morocco is not a Contracting Party, recognizes the right of innocent passage, a concept accepted by Morocco.

36. Of the two coastal States, both Morocco and Spain are Parties to the United Nations Convention on the Law of the Sea, opened for signature on 10 December 1982. Although the Convention has not yet entered into force, it may be regarded as reflecting the evolution of international law. This Convention lays down the principle of the right of unimpeded transit passage, a principle which does not conflict with that of the right of innocent passage, but places additional obligations on the coastal States.

37. In summary:

(a) The coastal States bordering the Strait exercise their jurisdiction over its waters, the seabed and the subsoil thereof, and the superjacent air space;

(b) The States must respect the users' right of expeditious and continuous passage. They may not in principle suspend it even temporarily.

A. Consequences of the construction of a permanent link

38. The studies made by the two countries have arrived at the conclusion that the construction of a permanent link is lawful, since it would be situated within their territorial waters. This conclusion is admissible in principle, subject to two conditions:

(a) Respect for the right of unimpeded transit passage for international navigation;

(b) The absence of consequences entailing legal liability and affecting either the two parts of the high seas linked by the Strait or the coastal States of the region.

39. This would probably rule out certain technical options, such as the construction of a causeway, which would have the effect of modifying the ecological balance of the Mediterranean through an increase in salinity.

40. It would also be necessary, during both the construction and the operation of a permanent link, to take all the appropriate measures to ensure continuity and safety of navigation.

B. Action to be taken

41. The choice of technology for constructing the permanent link should be made in the light of the legal considerations already described. A specific bilateral agreement would have to be concluded between the two coastal States; it would delimit the territorial waters, define the status of the structure in relation to the two countries and attribute the precise responsibilities arising from its construction, existence and operation.

42. The organization of navigation, especially its safety aspects, poses an international problem. In that regard, the International Maritime Organization has already taken action by adopting, on 20 December 1973, a scheme designating two sea lanes for traffic in the Strait of Gibraltar. The problems arising from the construction of a permanent link seem to be broader in scope, and it would be desirable to study in detail the possible international repercussions and the way to counteract them through appropriate measures, taken by the competent organizations, so as to ensure free, expeditious and safe passage.

43. The possible legal liability for damage poses a problem which cannot be resolved solely by the two States concerned. Indeed, the damage may be of various kinds and may be extensive in scope; it may be suffered by the structure itself, by shipping or by the two coastal States. It would appear

to be essential to study the question of a guarantee fund in which the users would participate (E/1983/87/Add.1).

44. On the subject of legal issues, a study was prepared for the Marrakesh Colloquium. This document explains in principle the various juridical aspects of establishing a permanent link, including the necessity of forming a treaty between Spain and Morocco, which would include the formulation of concessions, the institutional structure of the actual construction and the structure for operating the crossing upon completion.

45. These subjects, developed in alternative solutions and taking into account a certain parallelism between the Gibraltar and Channel crossings could form the basis of the detailed work that would have to be elaborated upon selection of certain specific schemes.

V. ECONOMIC ASPECTS

46. The fixed link was estimated to cost about $US 5 to 10 billion. After completion of all the necessary studies, the construction is estimated to take about 10 years. The cost of studies is estimated at 5 to 10 per cent of the construction cost.

A. Traffic

47. As part of the studies on traffic, the transport flow model was refined. The economic studies dealt with the analysis of the flow of transport through the Strait and the benefits that the fixed link would offer in terms of trade. It is supposed to contribute to the restructuring of the regional transport system (currently dominated by maritime transport, which accounts for over 85 per cent of Africa's foreign trade) by improving overland transport and establishing some sort of balance between overland and maritime transport. The economic studies dealt with the France/Iberian Peninsula/Maghreb corridor. An additional study on a Tangiers/Dakar/Abidjan/Lagos highway is needed before any accurate conclusions on the cost-effectiveness of the link can be drawn. Studies currently available point to considerable economic potential of a fixed link in its "area of influence" - namely, in the countries that would be served directly or indirectly by it.

48. The discussions during the Marrakesh Colloquium tended to underline the weak growth patterns of forecast traffic. However, it was also pointed out that a revision of those figures could indicate different growth ratios especially with the recent developments enveloping Europe and its trading partners.

B. Funding

49. A study on possible international financing schemes considered during the same discussions proposed:

(a) A methodology of project financing including risk coverage;

(b) Possible financing options.

50. It concluded that all large projects faced seemingly insurmountable legal and financial barriers at the beginning. However, experience had shown that all difficulties were resolved in time.

51. As the Common Market of the European region is in the process of being established, the proclamation of the Union of Maghreb States (UMS) will introduce important geopolitical modifications in the region. Thus, the fixed link will be placed at the centre of gravity of the exchange between EEC and the Maghreb.

VI. FUTURE ACTIVITIES

A. Work Plan 1991-1993

52. A Work Plan for future studies has been prepared by the Joint Committee in the light of the results of previous studies and in accordance with the recommendations of the Marrakesh Colloquium. The Work Plan is foreseen to be completed in the 36-month period from January 1991 to December 1993.

53. The objective of the present Work Plan is to submit to the Governments, by the end of 1993, a feasibility study of the project, including recommended action programmes for implementing a first linking structure, on the basis of analysis of long-term alternative policies for the development of the Europe-Africa, multi-modal corridor across the Strait of Gibraltar. In broad outline the plan consists of five working programmes dealing respectively with the following areas:

1. Physical environment

2. Engineering

3. Socio-economics

4. Legal aspects

5. Project evaluation

B. Directives for future activities in five areas of the Work Plan

1. Physical environment

54. Activities related to the physical environment will be guided by the following directives:

(a) Specialized observation networks (geodetic, meteorological, oceanographic - measurements of tides and waves - and seismological), installed in the last decade within the scope of previous study phases, will be reshaped and adapted to the specific requirements of the project, especially for the purpose of providing chronological series of observations as would be required for future design. Once adapted and revised, the networks will be entirely transferred for operation to adequate institutes of each country;

(b) Geological and geotechnical information will be collected and provided to consultants responsible for the basic designs to be developed within the engineering programme area. Operations for the acquisition of such data will be developed as envisaged by the Work Plan and adjusted in the light of the progress made, so as to provide a solid base for the technical feasibility of basic designs;

(c) Geological and geotechnical reconnaissance, contrary to the previous study phases, will no longer be restricted to indirect reconnaissance methods. The planned investigations include (i) construction of test galleries and shafts at both sides of the Strait; (ii) off-shore operations for a detailed study of potential bridge foundation sites, including video inspection, geophysical reconnaissance, sampling and shallow drilling; and (iii) off-shore shallow and deep drilling operations for geological investigation and assessment of the tunnelability of the terrains in the Sill Route (fig. I).

2. Engineering

55. The activities within the engineering programme area are aimed at producing basic designs for each of the retained solutions. These designs will be developed at an appropriate level of detail, so as to show technical feasibility and to yield construction cost estimates within reasonable margins of certainty. The solutions presently retained for basic design are the following:

(a) Bridge solution through the Sill Route (fig. III), consisting of a 28 km structure for road traffic with: (i) two access, off-shore viaducts at a water depth of up to about 50 m, and navigation clearance of 25-70 m; (ii) a main bridge about 18 km long, with a series of suspended spans between A-shaped, concrete pylons supported by gravity piers, self-resistant to ship collision, and founded at a maximum water depth of 300 m. Main structure

suspended span is to be determined in the range of 2,000-3,500 m as a result of ongoing studies. Basic solution is open for variants permitting both road and rail traffic;

(b) Tunnel solution (fig. IV), excavated in the Sill Route, consists of: (i) a 50-km-long three-gallery railway tunnel, consisting of two single-track main tunnels plus a service gallery in between, with an undersea central stretch of 28 km; (ii) a maximum ramp of 2 per cent, following a profile with maximum water depth of 300 m and 100 m overburden of terrain; and (iii) terminals in both sides of the Straits for ordinary rail traffic and road traffic ferried on special shuttle wagons as in Eurotunnel straits-crossing technology;

(c) An additional bridge solution, subject to confirmation by the Joint Committee, might also be studied. This solution, proposed at the Marrakesh Colloquium by a number of distinguished participants, would basically consist of a 14 km suspended road bridge through the Strait Route (route A in fig. I), with two main spans of about 5,000 m and two lateral compensating spans of about 2,000 m. The three pylons holding the structure would be supported by gravity piers self-resistant to ship impacts, founded at a maximum water depth (central pier) of only 450 m, which could be possible due to the presence of the undersea monticule M447 favourably located at the middle of the Strait Route (fig. I).

3. Socio-economics

56. The work scheduled under the programme on socio-economics is aimed at producing traffic estimates through appropriate methodological refinement of available traffic models, as developed in previous studies. This improvement is sought in the following directions:

(a) Improvement of the available traffic database through intensive complementary surveys, and application of long-term, scenario-based prospecting techniques;

(b) Selective disaggregation of spatial and conceptual zoning of the available model, especially in relevant geographical areas and traffic categories;

(c) Development of methods for evaluation of project-created traffic in the neighbouring area heavily influenced by the project.

4. Legal aspects

57. Within the programme area related to legal aspects, efforts will be continued to adapt the project to international maritime and environmental requirements. Specific studies will be started on institutional and financial schemes for project implementation.

5. Project evaluation

58. Under the programme on project evaluation, work is specifically focused on producing the feasibility study to be submitted to the concerned Governments. The study is planned to be approached according to standards internationally accepted, covering all aspects of feasibility, including economic, financial, juridical, social and environmental aspects.

VII. CONCLUSION

59. The secretariats of ECE and ECA affirm that the necessary research is being pursued in earnest and that the Governments of Morocco and Spain are closely following the recommendations made in previous years by the Economic and Social Council.

60. The technical work consists of studies and sophisticated research. Various scientific institutions are now involved, and the project aims to be a driving force in this field of scientific pursuit. It is likely to lead to advances in both marine science and construction methods (boring techniques, length of bridge spans, etc.). The two countries involved continue to establish conscientiously the technical, legal and financial basis for this important project. For these reasons, every effort should be made to encourage the international community to assist the effort.

61. As in the past, the secretariats of ECA and ECE request the Economic and Social Council to underscore the international nature of the project and encourage the United Nations to participate more actively in its related studies through the Economic Commissions for Africa and Europe, among others. The Council is requested to confirm the mandate previously given to the two Commissions and allocate adequate resources to them, to enable them to make significant progress in following the developments related to the project on the Europe-Africa permanent link through the Strait of Gibraltar.

Notes

a/ E/1983/87 and Add.1 and 2; E/1985/108; E/1987/46; E/1989/58.